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The Small Cell Revolution

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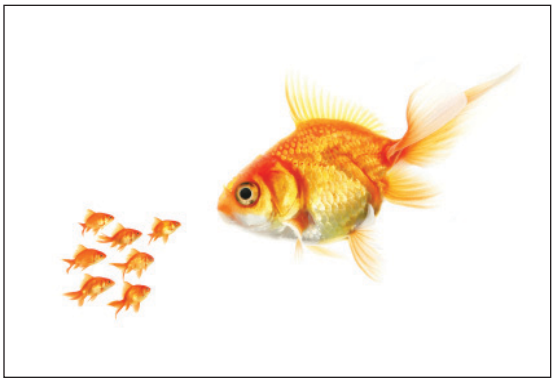

Several years back, Apple was releasing a new version of the iPod every few months, or so it seemed, and each new version was smaller than the previous. Saturday Night Live produced a skit that lampooned the product announcements by Steve Jobs, starting with the iPod Nano, and ending with the fictional iPod Invisa, which held all the music in the world invisibly. (Ironically, this pre-sages the iCloud.) The comedy in the SNL skit hinged on market confusion surrounding the Nano and the small devices in the product family. But, this article isn't about sexy consumer products, like the diminutive devices from Apple. It's about the growing confusion around another small device technology that represents the future: small cells.

Small cells are known by several names, including pico cell, micro cell, and femto cell. Today, many people still associate the category with femto cells, which were designed and deployed for small coverage, mainly indoors, but the discussion is much larger. This is partly due to the fact that small cell, as a technology, has only been realized in the past five years and operators are still in the first phases of deployment.

Unlike femto cells, small cells are engineered to provide greater capacity outdoors, can manage considerable bandwidth, and augment macro cell coverage. They are deployed in arrays, can be highly directional, and can deliver capacity in areas unreachable by traditional macro cells, the cellular sites (i.e. towers) that make up the larger wireless network.

Tony Goodman, Manager, Telecom Design Engineering, Sprint, succinctly explained the differences between the different "sizes" of cells. "Picocells and Metrocells are simply single sector base stations that utilize the same core equipment as the macro network. Femtocells utilize customer internet access for backhaul and have separate core equipment connecting them to the network."

Whether or not their public profile will ever approach

the level of iPods, one thing is for sure: small cell technology is here to stay, and a critical component in the heterogeneous networks of the future that will enable CSPs to meet capacity demands.

Small Cells—Why Now?

The discussion of small cell technology has changed because demands have shifted, pushing operators to investigate new strategies for delivering the promises of next-generation mobile experiences.

"In the past 5-years there has been a tremendous surge in smartphones and data usage," explained Jay Stewart, Director of Ethernet solutions for JDSU's Communications Test and Measurement business segment. "Another way to add capacity is to take advantage of small cells." he said.

Inherent in this market situation is a need for speed—not connection speed, but speed to market. It's easy to see from the current marketing campaigns in mature markets that 4G coverage is a top area of competition among major carriers. One problem though, in dense urban areas (which have been some of the first to have their 4G service turned on), is the Swiss cheese effect; many pockets of spotty coverage in an otherwise "covered" area.

As a solution to this dilemma, Amir Makleff, CEO, BridgeWave Communications, underlined another key reason why small cells have entered the discussion today: "Small cells give the operators the flexibility and speed to economically expand and improve 4G coverage in their networks."

Network Technology and the HetNet

Most operators see the heterogeneous network, or HetNet, as the best way to address coverage and capacity needs for next-gen networks. These networks will be comprised of both micro and macro sites utilizing the same core equipment. But what kind of network technology is required to successfully manage the HetNet?

Small cells function like macro cells in many ways, so a lot of the network technology is the same. "Additional Pico gateways may need to be added for management reasons, but they function exactly the same as a Macro BTS." explained Tony Goodman. Looking to the future, the consensus is that self-optimizing, monitoring, and adapting technology is the path forward. In a sense, we're talking about a smart network.

Carriers estimate the ratio of small cells to macro will reach 20:1

David Swift, Director of Smallcell Solution Marketing, Alcatel Lucent, defined the key enablement of the HetNet as, "Self-Optimizing Networks (SON) technology, developed by Bell Labs, which continually monitors the small cells performance, the traffic type and source, and then adapting itself automatically to achieve optimal performance as part of the cellular network. Looking forward, SON is a key part of HetNet which expands interworking between small cells and macro cells to the next level."

Amir Makleff agreed, adding, "The backhaul solutions for small cells will need to be self-optimized (SON) and include service aware Ethernet switch technologies such as QoS and VLAN along with the high capacity capabilities that allow for ring, mesh, and daisy-chain topologies."

Upsides and Downsides

It almost a pre-drawn conclusion that small cells can provide considerable savings for operators, but what kind of numbers are we talking about? David Swift says a small cell deployment, "provides a savings of over 30% compared to a traditional macro upgrade." Additionally, Swift continued, "Metro small cell delivers more that financial savings to an operator, bringing large improvements in overall throughput and customer satisfaction: a key differentiator to any network."

The size of small cells allows them to be deployed in areas that are unreachable by macro sites, like in underground train tunnels, or between narrow buildings in dense urban areas. Small cells have a lower power requirement, and sometimes face fewer municipal regulatory restrictions.

There are also spectral benefits. "With the spectral limitation carriers face, small cell represents a way to add additional sectors without adding additional spectrum," said Tony Goodman.

No solution is without challenges, though. Here is a basic bullet list of some of the challenges operators face when deploying arrays of small cells:

- Backhaul: The traditional method of pulling fiber to towers will not work with small cell
- Complexity: Managing the large number of small cells
- Distance: Lower powered sites have shorter coverage distance
- Availability: Small cells have yet to be implemented en masse
- Equipment: Managing the large number of deployed small cells requires additional core equipment

Deployment Timeline

Every CSP I explored for this article has invested significantly in small cell, and described small cell as a core part of their network evolution. On the vendor side, David Swift revealed that, "Alcatel-Lucent has 27 commercial deployments that can only be described as a market and technical success."

Clearly the ball is in play and moving quickly. Still, what does the market look like for small cells, and to what extent will they be deployed?

According to both carriers and vendors, we will see a massive uptick in small cell deployments over the next two years. The popularity of small cell will only increase as more and more users move to 4G. Jay Stewart explained that most operators are in phase one of small cell deployment. "Today, providers are in the planning stage and starting trials," said Stewart. "We see the uptick still 6-12 months out. This will be crucial to 4G/LTE deployments as use of smartphone and tablet devices – which demand more and more data – continues to skyrocket."

Tony Goodman with Sprint agreed, adding that, "While growth over the next 2 years may be limited, once the 4G LTE systems are loaded with users and capacity becomes a concern, the small cell program will grow rapidly to address the issues."

Operators' 4G deployments create pockets or gaps in 4G coverage that will only be filled by the small cell.

The ratio of small cells to macrocells will be on the, "order of 5:1 to 20:1, depending largely on population densities in urban or sub-urban areas," said Amir Makleff, based on carrier projections.

Small Cell Sells

Small cell captured a lot of attention at this year's 4G World, and it's no wonder why. The diminutive sites are, "required by operators in next-gen 4G networks to allow users to experience the promise of the tens/hundreds of Mbps speeds to their devices," said Makleff. "As cell site spacings get closer with 4G/LTE, these outdoor picocells will be needed to augment the macrocell for ubiquitous 4G coverage."

And it's not just a few lone voices cheerleading for small cells. In order to meet demands, network evolution strategies from all major operators lean on small cells. "The mobile industry has established a consensus that heterogeneous networks comprising a mix of small and large cells will be essential to satisfy the capacity, speed and performance requirements of the future," said David Swift.

Small cell no longer refers to femto-cell, but instead a category of cell sites that function on macro core backhaul technology and take scalability, automated configuration, and rapid deployment to new levels– and they are a crucial tool to address mobile capacity constraints service providers are facing today.